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BASIC MRI PHYSICS – A VISUAL INTRODUCTION FOR LAYMEN

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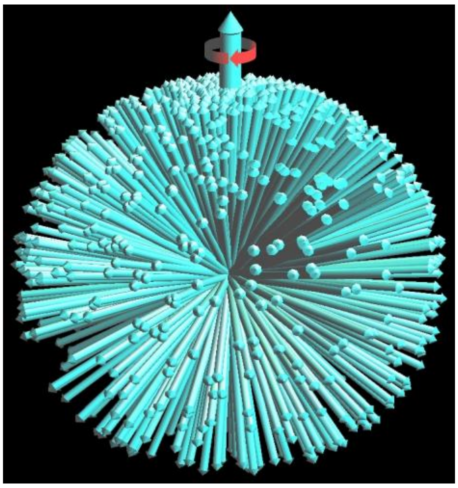
Magnetic resonance imaging (MRI) has become one of the most important imaging modalities due to its flexibility and high contrast between soft tissues. It is also known as a conceptually challenging technique. The purpose of the presentation is to demonstrate that MR techniques are maybe not as difficult to understand as often said [1]. In fact, the basic magnetic resonance phenomenon can be understood intuitively and even demonstrated with very simple means, including freely available software running directly in any browser [2]. A wide range of MRI techniques can be visualized [3] and understood in detail, certainly also by people who are not trained in physics [4]. The presentation is aimed at those new to MR, and those who will teach it.

But can simple explanations based on classical mechanics be trusted? The basic magnetic resonance (MR) phenomenon is often said to rely on quantum mechanics which is incomprehensible to most people. In fact, MR is not a quantum phenomenon [5]. Spin and certain kinds of nuclear couplings relevant to MR are indeed of quantum origin. Spin is important for understanding MR, but even though this effect is mind-boggling, most people have little difficulty taking it for granted. Once done, all the remaining MRI theory and typical spectroscopy, follows from the common sense expressed in classical mechanics (for MR in nuclear ensembles, quantum mechanics can be shown rigorously to reduce to classical mechanics). Unfortunately, typical attempts of explaining MR in terms of quantum mechanics contain severe errors [1].



The precessing equilibrium spin distribution is near isotropic from both classical and quantum perspectives.

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